

ACCESSION #: 9910200242

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station, Unit 3 PAGE: 1 OF 14

DOCKET NUMBER: 05000382

TITLE: Reactor Shutdown Due to Loss of Controlled Bleed-Off Flow
Caused by Rotating Baffle Failure

EVENT DATE: 09/10/1999 LER #: 99-014-00 REPORT DATE: 10/12/1999

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100%

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: RCS COMPONENT: AB-P MANUFACTURER: B580
REPORTABLE EPIX: Yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On September 10, 1999, with Waterford 3 operating normally at 100% power, a Plant Monitoring Computer (PMC) alarm for Middle Seal Pressure Low on Reactor Coolant Pump (RCP) 2B was received. Upon investigation, Operations personnel discovered decreasing RCP seal pressures, along with decreasing Controlled Bleed-Off (CBO) flow. Operations personnel entered the appropriate Off-Normal procedure for a reactor coolant pump malfunction. CBO flow decreased to zero gallons per minute (gpm), and middle and upper seal pressures also decreased. Operations personnel manually tripped the reactor and secured RCP 2B. Initial disassembly involved removal of the seal for RCP 2B and inspection of the rotating baffle. Initial inspection showed the baffle's joint securely attached. However, the baffle had an observed through-wall crack 360 degrees around the inner surface of the inner cylinder. The cause of this event is believed to be fatigue-induced failure of the rotating baffle of RCP 2B. Corrective actions include replacing the one-piece rotating baffle with a more robust two-piece rotating baffle, completing and finalizing a Finite Element Analysis of the baffle, realigning RCP 2B, and revising the RCP maintenance procedure to include checking and correcting, as necessary, the RCP shaft shoulder to baffle joint for perpendicularity and flatness. This event did not compromise the health and safety of the public. A previous plant shutdown due to failure of the RCP 2B baffle was documented in LER 99-011-00 dated August

31, 1999.

END OF ABSTRACT

TEXT

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REPORTABLE OCCURRENCE

On September 10, 1999, with Waterford 3 operating normally at 100% power, a Plant Monitoring Computer (PMC) alarm for Middle Seal Pressure Low on Reactor Coolant Pump (RCP) 2B was received. Upon investigation, Operations personnel discovered decreasing RCP seal pressures, along with decreasing Controlled Bleed-Off (CBO) flow. Operations personnel entered the appropriate Off-Normal procedure for a reactor coolant pump malfunction, CBO flow decreased to zero gallons per minute (gpm), and middle and upper seal pressures also decreased. Operations personnel manually tripped the reactor and secured RCP 2B. This event is reportable under 10CFR50.73(a)(2)(iv) as an actuation of an Engineered Safety Feature or the Reactor Protection System.

INITIAL CONDITIONS

At the time of this event, Waterford 3 was operating in Mode 1 at 100% power. There was no major equipment out of service specific to this event and no TS Limiting Conditions for Operation Action Statements were in effect specific to this event.

EVENT DESCRIPTION

On September 10, 1999, with Waterford 3 operating normally at 100% power, a Plant Monitoring Computer (PMC) [ID] alarm for Middle Seal Pressure Low on Reactor Coolant Pump (RCP) 2B [AB-P] was received. Upon investigation, Operations personnel discovered decreasing RCP seal pressures, along with decreasing Controlled Bleed-Off (CBO) flow. Operations personnel entered the appropriate Off-Normal procedure for a RCP malfunction. CBO flow decreased to zero gallons per minute (gpm), and middle and upper seal pressures also decreased. Operations personnel manually tripped the reactor and secured RCP 2B. Initial disassembly involved removal of the seal for RCP 2B and inspection of the rotating baffle. Initial inspection showed the baffle's joint securely attached. However, the baffle had an observed through-wall crack 360 degrees around the inner surface of the inner cylinder.

The reactor coolant pumps are Byron Jackson vertically oriented single stage centrifugal pumps, Type 36x36x39 DFSS. These pumps have three face type mechanical seal stages in series with a fourth

vapor stage to seal Reactor Coolant System (RCS) pressure of 2250 psi. Pressure Breakdown Devices (PBD) [OR] (capillary tubes) are provided (one for each of the three face type mechanical seals). Each PBD carries a leakage flow in parallel with the face type mechanical seals of each stage. PBDs are designed to decrease the pressure across each face seal such that full RCS pressure will not be exhibited to a single seal face during operation.

The mechanical seals [SEAL] are lubricated and cooled by a 1.5 gpm controlled reactor coolant leak-off. Reactor coolant enters the seal area at about 1.5 gpm from the heat exchanger/rotating baffle [BAF] area. RCS coolant flowing through the seal area is cooled by a 45-60 gpm flow of CCW supplied to the RCP heat exchanger assembly. The RCP heat exchanger assembly contains passages for CCW to remove heat from the reactor coolant, which decreases RCS temperature from approximately 550 degrees F to approximately 140 degrees F in the seal cavity.

RCS coolant enters below the heat exchanger near the pump shaft. Flow is directed up and around two heat exchanger cylinders by two cylinders of a rotating baffle. The rotating baffle is attached to the pump shaft by means of a bolted joint. The purpose of the two heat exchanger cylinders and two rotating baffle cylinders is to provide more RCS surface area contact with the heat exchanger for cooling, and to ensure proper mixing to minimize thermal stratification.

DATA ANALYSIS

Investigation into the rotating baffle failure in RCP-2B included the following:

- o Examination of the failed baffle for metallurgical and other evidence of the nature of the failure.
- o Review of the operating characteristics (run time and vibration data) of the pump in the period leading up to the failure.
- o Structural evaluation of the baffle to understand stresses due to loading.

Examination of the Failed Baffle

On 9/19/99, EOI examined the fracture surface on the RCP-2B rotating baffle removed after the recent failure on 9/10/99. The cracks appeared to originate at multiple sites on the outer diameter (OD) of the

inner baffle wall and propagate radially toward the inner diameter (ID). The crack origins were in the area where the inner radius transitions to the straight wall. The top of the surface around the circumference had several ridges spaced at various intervals from 1/2 to 1 1/2 inches apart. The area between ridges was a smooth, brittle-appearing, fracture surface typical of fatigue fracture. The ridges were steps where two crack fronts met. On the ID surface where the cracks ended there was some small amount of plastic deformation as the baffle finally separated. A large portion of the fracture surface, from 120 to 160 degrees, was badly distorted due to impacts after fracture but there was evidence of the same ridges as the rest of the fracture surface. There were scoring marks on the outside of the outer wall about 8 inches long and up to 2 inches wide near the bottom. There were similar scoring marks on the opposite side of the baffle on the inside of the outer wall.

Operating Characteristics

RCP 2B exhibited normal steady state vibration following the previous forced outage in August 1999, which was also the result of a rotating baffle failure. Vibration levels were approximately 11 mils Peak to Peak (P-P) overall, 5 mils (P-P) 1X, 7 mils (P-P) 2X, 0.5 mils (P-P) 5X, and 0.8 mils (P-P) 10X. These readings were similar to data from May 1999, as well as earlier steady state data. While the 2X reading is higher than the 1X and higher than desirable, similar values have been seen in this and other pumps without adverse consequences.

On approximately August 21, 1999, vibration at 5X decreased gradually to 0.2 mils over 1 to 2 days then increased to 2.0 mils over 6 days followed by a decrease back to 0.6 mils over 4 days. During this time, the 5X phase went through a complete 360 degree phase change.

Following the change in 5X vibration, levels remained steady until approximately September 8, 1999, when a very gradual decrease of approximately 0.5 mils in overall and 1X occurred during a 2 to 3 day period. On September 10, 1999, at approximately 16:00 vibration levels showed a sharp decrease of approximately 2 mils in overall and 1X over a 2 to 3 hour period. On September 10, 1999, starting at approximately 19:00, vibration levels started increasing sharply. Overall vibration increased from 10 mils to 23 mils, 1X increased from 4 mils to 19 mils, 2X increased from 6 mils to 11 mils and 5X increased

from 0.6 mils to 1.0 mils over a 40 to 50 minute period. During this time seal performance parameters also degraded and Valve and Loose Parts (VLP) Monitoring alarms occurred.

Structural Evaluation of the Baffle

Prior to the latest baffle failure, the OEM was already preparing a Finite Element Analysis (FEA) computer model to determine stresses in the rotating baffle. This analysis was a corrective action for the previous baffle failure in August 1999 (reference LER 99-011-00). The OEM had not performed a detailed stress analysis for the rotating baffle when it was originally designed, because the loads on the baffle were believed to be negligible. A detailed analysis was also not performed when the design of the baffle was changed to implement a one-piece baffle instead of a two-piece baffle. During the redesign of the baffle the thickness of the OD of the inner baffle wall had been reduced from 11/16 inches to 5/16 inches. This location corresponds to the observed failure initiation points. Following the latest failure, additional personnel from two consulting companies were brought on site to work with the OEM and expedite the FEA. One consultant also prepared an independent FEA model of the baffle. EOI personnel are independently preparing another FEA model. Additional OEM personnel were also brought on site to aid the investigation.

Several new dynamic loads were identified and modeled. These loads were not identified during the original design of the baffle. The baffle is attached to the pump rotating element and is subject to vibration loading imposed by the rotating element. An important contributor to the vibration is the inertial effect of the water in the annuli between the rotating baffle and the stationary heat exchanger when the rotating baffle is subject to lateral acceleration. This fluid inertia loading of the baffle was not recognized until after the 1996 bolting failure in RCP-2B.

Misalignment of the various parts of the pump rotating element will also create alternating loads and increase vibration. Misalignment of the pump rotating element can occur by various means including motor to shaft misalignment, heat exchanger misalignment and a shaft shoulder that is out-of-square. These misalignment conditions identified in RCP 2B place the rotating baffle off center in the heat exchanger creating an alternating load as the baffle moves closer and farther away from the heat

exchanger during each revolution. These conditions have been identified as additional loading on the rotating baffle.

Another recently identified load on the baffle is due to the amplification of the dynamic loads by a resonance frequency in the rotating baffle. Dynamic loads are amplified if the structure has natural frequencies near the operating frequencies of the component. The FEA models all estimate the lowest natural frequency of the rotating baffle to be in the range from approximately 78 - 108 Hz, the second lowest frequency to be in the range from approximately 119 - 162 Hz and the third lowest frequency to be in the range from approximately 162 - 222 Hz. A limitation of the FEA models, due to uncertainties in the hydrodynamic mass used in the model, is that they can only predict the approximate range of the rotating baffle natural frequencies. The lowest natural frequency is very close to the vane passing frequency of the pump at approximately 100 Hz and the third lowest frequency is very close to the second harmonic of the vane passing frequency (10X or 200 Hz). One of the FEA models was run in the forced response mode and shows that the third lowest frequency is significantly excited by vibration type loading. Therefore, substantial dynamic amplification, especially of the 10X frequency, is expected but the exact magnitude can not be determined because of the uncertainty in the rotating baffle natural frequencies.

Considering the newly identified baffle loads, the FEA models predict the actual baffle alternating stresses to be in the range of 25 to 40 ksi. The models predict the alternating stresses to be in the range of 7 to 13 ksi for the various frequencies. These alternating stresses are slightly below the ASME allowable alternating stress value for high cycle fatigue (approximately 14 ksi). The FEA models all predict that the maximum stress in the baffle is at the location where the baffle failed. The stress at the location of failure is a little more than twice that at the next most limiting location in the rotating baffle. The model results support the metallurgical evaluation in that it predicts that a fatigue failure due to the dominant identified loading of the baffle would be expected to initiate at the observed failure-initiation point.

The latest failure in the baffle occurred after approximately 33 days operation of the baffle. The previous baffle failed after approximately 946 days operation. This previous failure is documented in LER 99-01 1 -00 dated August 31, 1999. The explanation for the large difference in operating time prior to failure is due to the shape of the fatigue curve. In the high-cycle fatigue range with the known stresses imposed on the one-piece baffle, small differences in stress levels lead to large changes in fatigue life. A load causing a 14.2 ksi alternating stress at the pump operating frequency of 20 Hz would reach the fatigue limit in 33 days. A load causing an alternating stress of 13.9 ksi would reach the fatigue limit in 946 days. Stresses much below 13.9 ksi would not be expected to reach the fatigue limit in any period of interest (10E11 cycles is equivalent to approximately 160 years of pump operation at 1X). Hence, in the high-cycle fatigue range, widely varying lifetimes are expected due to normal variations in applied loads and part conditions if the stresses are close to the fatigue limit.

In summary, the structural evaluation of the baffle predicts that the limiting location for fatigue caused by lateral loading of the baffle is where the failure occurred. The quantitative estimates of stress levels and allowable fatigue limits are somewhat uncertain. However, the estimates of applied stresses and allowable stresses are in close-enough proximity to say that failure due to fatigue from lateral vibration loading is credible. These results when combined with the observed failures suggest that the fatigue capacity of the design is marginal compared with the expected vibration loads in the pump.

CAUSAL FACTORS

Design Configuration and Analysis: Inadequate OEM Review of Design Change:

The pump OEM, Flowserve, was contacted concerning the cracked rotating baffle. Discussions determined that this rotating baffle design was not analyzed for cyclic loads since the baffle was considered a low stress pump component. The rotating baffle configuration was changed from a two-piece bolted arrangement to a one-piece arrangement. During the change to the one-piece arrangement the wall thickness of the upper inner cylinder was decreased from 11/16 inches to 5/16 inches. Additionally, the manufacturing process for the one-piece baffle had been changed from casting to forging.

A second result of this analysis was that two of the natural frequency modes of the one-piece rotating baffle were determined to be near the vane passing frequency (100 Hz) and the second harmonic of the vane passing frequency (200 Hz) respectively. As a result, using the FEA model determined that the 10X vibration in the rotor is considered to be a major contributor to baffle loading.

Equipment Degradation: Degraded Subcomponent Contributed to Failure:

In previous failures when the bolted joint loosened or failed it created differential movement between the shaft shoulder and the rotating baffle which resulted in deformation of the shaft shoulder. Measurements indicated an incline across the shaft diameter. An inclined surface would increase imbalance by putting the center of gravity of the rotating baffle off center from the center of rotation. Visual inspection of the shaft shoulder surface showed surface irregularities. Surface irregularities introduce higher mean stresses in the rotating baffle during the bolt torque process.

Maintenance: Equipment Left Outside of Acceptance Criteria:

The motor and rotating element are not centered in the hydrostatic bearing. Additionally, the heat exchanger is not centered. Misalignment increases vibration levels, which creates higher cyclic forces on pump and motor components. The magnitudes of these forces are believed to be a contributor to the forces acting on the rotating baffle.

CORRECTIVE ACTIONS

In order to repair RCP 2B, a two-piece rotating baffle of the original design was located and installed. This two-piece replacement rotating baffle is an acceptable replacement for the failed one-piece rotating baffle for the following reasons:

1. The two-piece rotating baffle has a thicker wall, at the critical failure location, than the one-piece rotating baffle. The wall thickness in the two-piece rotating baffle is 11/16 inches compared to 5/16 inches in the one-piece rotating baffle. This will reduce the actual stress in the two piece rotating baffle by greater than a factor of two.
2. Due to the structural differences, the two piece rotating baffle's nominal natural frequency is further away from the pump vane passing frequency. The increased separation from the pump vane passing frequency results in a reduced amplification factor that will reduce the actual vibration induced stress level.

For these reasons the two-piece rotating baffle will have much lower actual stresses and is acceptable for use until the next refueling outage.

Design Configuration and Analysis: Inadequate OEM Review of Design Change:

Complete and finalize the Finite Element Analyses performed by the OEM and an additional contractor. This model should include the observed cyclic inertial loading during start-up and normal operating conditions, thermal and other stresses. Also, investigate the uncertainties in the rotating baffle natural frequencies and the extent of cracking needed to cause a shift in natural frequency from above to below vane-passing.

Equipment Degradation: Degraded Subcomponent Contributed to Failure:

- 1) Lap shaft shoulder to flat - Completed.
- 2) Revise MM-008-030 to include checking and correcting as necessary, the RCP shaft shoulder to baffle joint for perpendicularity and flatness.

Maintenance: Equipment Left Outside of Acceptance Criteria:
Realign RCP 2B.

SAFETY SIGNIFICANCE

The actual safety significance of this event is negligible. Due to prompt operator action to trip the reactor and secure RCP 2B when seal pressures and CBO flow were decreasing, no additional pump assembly damage occurred and an uncomplicated, safe shutdown of the plant was initiated. The potential worst case implications of this event have been reviewed to ensure a safe shutdown of the plant would still have occurred without prompt operator action.

Because a RCP is not credited for accident mitigation or safe shutdown, the unavailability of a RCP would not be safety significant. Loss of flow from a single RCP coastdown during full power operation is analyzed in FSAR Section 15.3.1.1 with acceptable results. However, two other unlikely events can be postulated to be potential results of a rotating baffle failure. The first is perforation of the seal cooling heat exchanger, caused by debris or unbalance of the rotating baffle or its pieces. The second is a seized RCP shaft, caused by the unbalanced rotating baffle being wedged into the low tolerance space between the stationary heat exchanger cylinders. The likelihood of a seized RCP shaft has been determined to be negligible because the bolts attaching the baffle to the shaft would likely shear before shaft seizure. Therefore, this potential failure is not discussed further.

The aspect of rotating baffle damage that has been reviewed for safety significance is the potential affect on the RCP Seal Cooler, which is cooled by Component Cooling Water (CCW). In this instance, the rotating baffle damage was not sufficient to perforate the wall of the cooler. However, if the rotating baffle was damaged such that it breached the cooler wall, a path from the RCS to outside containment through the CCW system would be available, thereby causing an Interfacing System Loss Of Coolant Accident (ISLOCA). Because an ISLOCA allows RCS fluid to leak outside of containment, no fluid collects in the Safety Injection sump. Therefore, this event is more severe than an in-containment LOCA because recirculation cannot occur after depletion of the RWSP.

A previous engineering evaluation reviewed the potential of heat exchanger failure in response to IN 8954, "Potential Overpressurization of the Component Cooling Water System". This evaluation reviewed the heat exchanger from hydrostatic, hydrodynamic, and thermal stress perspectives, and concluded that cracking of the heat exchanger, causing a break in the RCS pressure boundary, was not a credible event. However, the study did not account for potential damage caused by a failed rotating baffle. Previous occurrences of rotating baffle and baffle bolting failures, causing forced shutdowns have occurred. These occurrences have resulted in slight heat exchanger damage/scuffing in the past, but have not resulted in heat exchanger perforation.

In the event of a perforated heat exchanger, the leakage would be mitigated through RCP Seal Cooler

Isolation Valves CC-666A&B, CC-6651A&B, CC-679A&B, and CC-680A&B, which are located inside containment at the inlet and outlet of the seal coolers.

These valves are automatically actuated closed when the CCW outlet temperature at the heat exchanger reaches 155 degrees F. Normal CCW temperature at the outlet of the heat exchanger is approximately 130 degrees F. Any significant leak of RCS fluid at 545 degrees F into the CCW side of the heat exchanger is expected to cause the temperature to increase above 155 degrees F. Prior to valve closure, at 145 degrees F outlet temperature, an alarm annunciates in the control room. The valves close at 155 degrees F, but manual reset is allowed. However, if the valves are reset and the temperature does not fall below 145 degrees F within 100 seconds, the valves will re-close. This function is designed to detect a cooler leak/break and isolate the affected cooler, making operators aware of the potential ISLOCA. Prompt operator action will also be facilitated through a radiation monitor located on the RCP-CCW return header, with annunciation provided in the control room. In addition, each CCW loop contains a radiation monitor, which should indicate rising trends and/or alarm in the control room.

The cooler isolation valves are 1500 pound Class, flow under the seat, air operated globe valves. Upon review of the draft design basis review calculation, R is concluded that the valves are capable of closing at RCS pressures. Therefore, if the heat exchanger were to be perforated by the rotating baffle failure, the potential ISLOCA would be quickly isolated through the automatic action of these valves.

The piping between the coolers and the isolation valves is described on the applicable isometric drawings as being designed for 175 degrees F and 125 psig, and was hydrostatically pressure tested to 156 psig. However, per the isometric drawings, this piping is Schedule 80, ANSI-106, Grade B, carbon steel. Per the National Valve and Manufacturing Company, the maximum working pressure of this piping is 2,983 psig at 650 degrees F. Connection flanges between this piping and the heat exchanger are classified at 1500 pound Class. Per Mark's Handbook, a Class 1500, A105, carbon steel flange is rated for 2,685 psig at 650 degrees F. Therefore, it is unlikely that the flange, piping or valves would fail. However, in the unlikely event that this piping or flange were to rupture, the result would be bounded by the small break LOCA analysis described in FSAR Section 15.6.3, since the break would be inside of containment.

If failures of the cooler outlet isolation valve to close or a loss of offsite power (LOOP) were postulated with a perforated cooler, an ISLOCA could occur with a path for RCS fluid to outside of containment. A LOOP causes a loss of electrical supply to the Instrument Air (IA) compressors, thus causing a loss of IA. Because the CCW isolation valves are fail-open AOVs, these valves would open, once IA is lost. The likelihood that this scenario (catastrophic failure of the rotating baffle causing perforation of the heat exchanger and LOOP) could lead to core damage is calculated below.

The dominant scenario postulated that could lead to core damage begins with the failed rotating baffle, at a probability of 1.0 since the event actually has occurred. The probability of perforating the heat exchanger, given a failed rotating baffle, is assigned a value of 0.1, based on engineering judgement developed for the previous rotating baffle failure. This recent baffle failure substantiates this assumption in that the baffle damage was more severe, yet only minor heat exchanger scarring occurred.

An assumed LOOP caused by the W3 plant trip (with a probability of 0.017), then results in the RCP Seal Cooler Isolation Valves failing open. The resulting ISLOCA causes depletion of the RWSP (to the RAS setpoint) in over 500 minutes. During this time, operators can load the IA compressors onto the Emergency Diesel Generator (EDG), thus providing air to the cooler isolation valves and isolating the ISLOCA. The failure probability for this operator action is 0.001 3, based on the time available to perform this action. An additional recovery action is related to depressurizing the RCS to the point at which the CCW containment isolation valves are able to close. These valves are also air-operated, fail open valves, with air accumulators to maintain the valves closed. Operators would need to align the essential air system to these valves to replenish the accumulators and maintain them closed in the long term. This action is assumed to be highly dependent on the previous operator action to diagnose the correct recovery action and is, therefore, given a high failure rate of 0.5. The probability of core damage for this scenario is calculated to be $1.5\text{E-}6$. This is the potential probability that core damage could have been reached during the postulated event, which did not actually occur. The probability of core damage due to a similar future event would be a lower value because the probability of failing the rotating baffle would be less than one.

One last potential impact of the postulated ISLOCA that was reviewed is overpressurization of the CCW system. Upon SIAS initiation, the two CCW trains split into redundant A and B trains, with the A train continuing to supply the RCP coolers. However, the two trains continue to be connected through their common surge tank. Therefore, although the RCS fluid will directly flow into the A train, causing potential overpressurization, affects will also be seen by the B train once the surge tank is filled and pressurized. The overall affects of the overpressurization on CCW operation should be small. Although some decreased efficiency will be seen due to the influx of the higher temperature RCS fluid into the CCW system, this impact should be minimal and not affect the components that CCW supports. The small increase in system pressure should also not affect pump operation.

The largest impact of the CCW overpressurization is the potential for flooding in essential areas due to overfill of the surge tank and lifting of relief valves. The potential overpressurization of the CCW system has been previously reviewed for worst case scenarios in the operability evaluation for a previous corrective action document. This corrective action document identified a potential for uncontrolled make-up to the CCW system at approximately 760 gpm (this does not affect the RCP ISLOCA scenario because CCW make-up will not be initiated due to filling by the RCS fluid). The flooding effects of approximately 195,000 gallons of fluid in the -35 level, primarily due to overflow of the CCW surge tank and floor drain collection into overflowing waste tanks, were reviewed. In relating this issue to the RCP/ ISLOCA scenario, an evaluation of expected flow rates prior to ISLOCA isolation in the 500th minute shows that no more than 190,000 gallons will enter the CCW system from this scenario. Thus, the evaluation bounds the ISLOCA scenario for the effects of flooding in the -35 level. Further, because the areas of potential flooding will not affect any of the operator actions postulated in the RCP/ISLOCA scenario, the potential overpressurization and overfilling of the CCW system will not change the probability scenario calculated above.

SIMILAR EVENTS

LER 99-011-00 was issued on August 31, 1999, to document a previous reactor shutdown due to the loss of CBO caused by failure of the RCP 2B rotating baffle. The corrective actions for the August 31, 1999, event were 1) perform an analysis of all forces acting on the one- and two-piece rotating baffles

utilizing a Finite Element Model; and 2) perform a failure analysis of the cracked rotating baffle and associated debris. At the time LER 99-011-00 was written, EOI was not aware of other dynamic loads acting on the baffle. As a result of the investigation of the September 10, 1999, event these loads were identified and modeled. One new contributor to the pump vibration was the inertial effect of the water in the annuli between the rotating baffle and the stationary heat exchanger when the baffle is subjected to lateral acceleration. An additional load is created by misalignment of the pump rotating element. A third load is due to amplification of the dynamic loads by a resonance frequency in the baffle. These additional loads have been previously discussed in the Event Description section and appropriate corrective actions are being taken to address them.

ADDITIONAL INFORMATION

Energy Industry Identification System (EIS) codes are identified in the text within brackets []

Form "COMMITMENT IDENTIFICATION/VOLUNTARY ENHANCEMENT FORM" omitted.

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